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Lachner, J.; Hou, Xiaolin; Christl, M.

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^{237}Np AMS WITH THE TANDY SYSTEM

Detection of low-level ^{237}Np concentrations using ^{242}Pu as reference

J. Lachner, X. Hou[1], M. Christl

The long-lived neptunium isotope ^{237}Np ($T_{1/2}$=2.1x10^6 a) is used in environmental applications [1] but also for dosimetry in nuclear facilities. Determination of ^{237}Np concentrations with α-spectrometry requires large amounts of sample material because of the long half-life and the abundant neighboring isotope ^{238}U complicates mass spectrometric measurements. AMS should overcome these restrictions.

AMS is usually applied to measure the ratio of a rare radioisotope to an abundant stable isotope of the same element. In the case of actinides AMS, measurements are mainly carried out relative to long-lived carrier isotopes. ^{236}Np ($T_{1/2}$=1.5x10^{5}a) could be an appropriate neptunium carrier isotope, but is difficult to produce and, if used, the relatively large amounts needed may lead to contamination of the ion source with ^{236}Np. This may cause problems with highly sensitive ^{236}U determinations. As an alternative we investigated ^{242}Pu as carrier material. The aim of our first tests at the TANDY AMS facility was to search for possible background interfering with the determination of low ^{237}Np concentrations and to determine the stability of the measurement of ^{237}Np relative to ^{242}Pu.

Normalization between different elements requires a higher effort to guarantee the comparability between standards, blanks and samples. First tests showed that the relative AMS efficiencies of Np and Pu depend strongly on the chemical consistence of the Fe matrix used to take up the trace amounts of Np and Pu. They varied by a factor of 4-5. In a standard dilution series of ^{237}Np and ^{242}Pu the samples with lower ^{237}Np/^{242}Pu ratios showed increased counting rates of ^{237}Np due to a ^{237}Np contamination in the Fe matrix. In a second dilution series (targets containing 0-180 fg ^{237}Np and 500 fg ^{242}Pu, Fig. 1) using a specially purified Fe solution, samples showed equal efficiencies for ^{237}Np and ^{242}Pu. A minor contamination of the Fe matrix with ^{242}Pu was observed. Correspondingly, the results shown in Fig. 1 were corrected for the ^{242}Pu rate of the Fe blank.

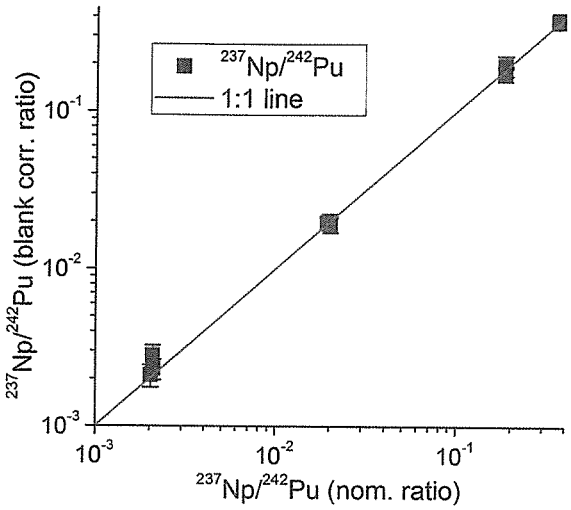

Fig. 1: *Comparison of nominal and measured ^{237}Np/^{242}Pu ratios in a standard dilution series.*

The conclusion from our tests is that for samples produced from Np and Pu standard solutions and incorporated into a Fe matrix, ^{237}Np/^{242}Pu ratios can be measured with AMS down to fg concentration levels. The relative isotopic yields were stable over time in all targets. Future studies will include the full processing of Np and Pu from artificial and real urine samples in order to develop a highly sensitive method of Np dosimetry using AMS. It has already been shown that a reliable chemical separation of both elements (Np, Pu) from environmental samples can be conducted [1].

[1] J. Qiao et al., Talanta 84 (2) (2011) 494

[1] *Risø Nat. Lab. f. Sustainable Energy, Risø, Denmark*

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Amanda Eisenhut, ETH Zurich
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